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Overflow induced turbulence in a deep ocean channel

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Diapyncal mixing processes in a deep ocean channel in the Lucky Strike region are investigated using microstructure data collected by an autonoumous underwater vehicle (AUV), moored current time series, lowered ADCP profiles and lowered CTD profiles. The distribution of the flow, the density, and the dissipation rate of turbulent kinetic energy in a deep ocean channel in the central valley of the Mid-Atlantic Ridge near 37°N is presented. Within the channel, mostly unidirectional, northward flow across a sill was present. The spatial distribution of the dissipation rate inside the channel was inferred using a horizontally profiling microstructure probe attached to an AUV. To the authors' knowledge, this is the first successful realization of a horizontal, deep-ocean microstructure survey. The magnitude of the dissipation rate was distributed asymmetrically relative to the position of the sill. Elevated dissipation rates were present in a segment 1 to 4 km downstream of the sill with peak values of $1 \cdot 10^{-7}$ W/kg. Flow speeds with a maximum of 20 cm/s and elevated density finestructure were observed within the same segment. Lowered and moored velocity observations showed large variability on semi-diurnal timescales. The measurements indicated hydraulic controlled flow to be established at least temporarily downstream of the sill. If hydraulic control is established a hydraulic jump is expected to occur downstream. Consistently, an upward displacement of the isopycnals was observed in the area where the hydraulic jump is expected from the velocity distribution. The spatial distributions of the flow, density and dissipation rate provide a consistent picture indicating deep-ocean mixing to depend heavily on the local bottom topography and flow conditions. Furthermore, the results nicely illustrate that horizontally-profiling AUV-based observations may be an efficient tool to study deep-ocean turbulence over complex terrain.